EXHIBIT 1

US005553852A

United States Patent [19]

Higuchi et al.

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[45] **Date of Patent: Sep. 10, 1996**

[54] **THREE-PIECE SOLID GOLF BALL**

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[21] Appl. No.: **271,953**

[22] Filed: **Jul. 8, 1994**

[30] **Foreign Application Priority Data**

Jul. 8, 1993 [JP] Japan 5-193065

[51] **Int. Cl.**[6] **A63B 37/06**

[52] **U.S. Cl.** **473/373**; 473/378

[58] **Field of Search** 273/228, 230, 273/218, 220, 219, 225, 229, 214, 217

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Primary Examiner—George J. Marlo

Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas

[57] **ABSTRACT**

A three-piece solid golf ball comprising a center core, an intermediate layer, and a cover. The center core (1) has a diameter of at least 29 mm, a hardness in the range of 45–80 JIS C and a specific gravity of less than 1.4. The intermediate layer (2) has a thickness of at least 1 mm, a specific gravity of less than 1.2, and a hardness of at least 85 on JIS C scale. The cover (3) has a thickness of 1–3 mm and a hardness of 50–85 JIS C. The ball has a good total balance of properties in that feeling and controllability are improved at no sacrifice of flying performance and durability.

8 Claims, 1 Drawing Sheet

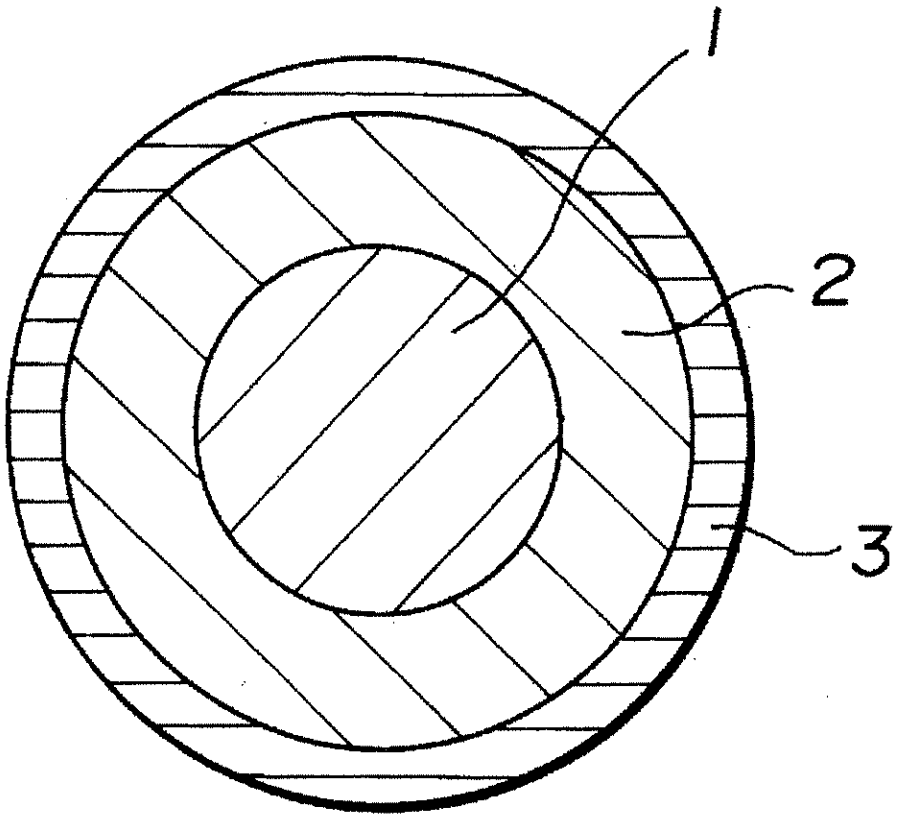
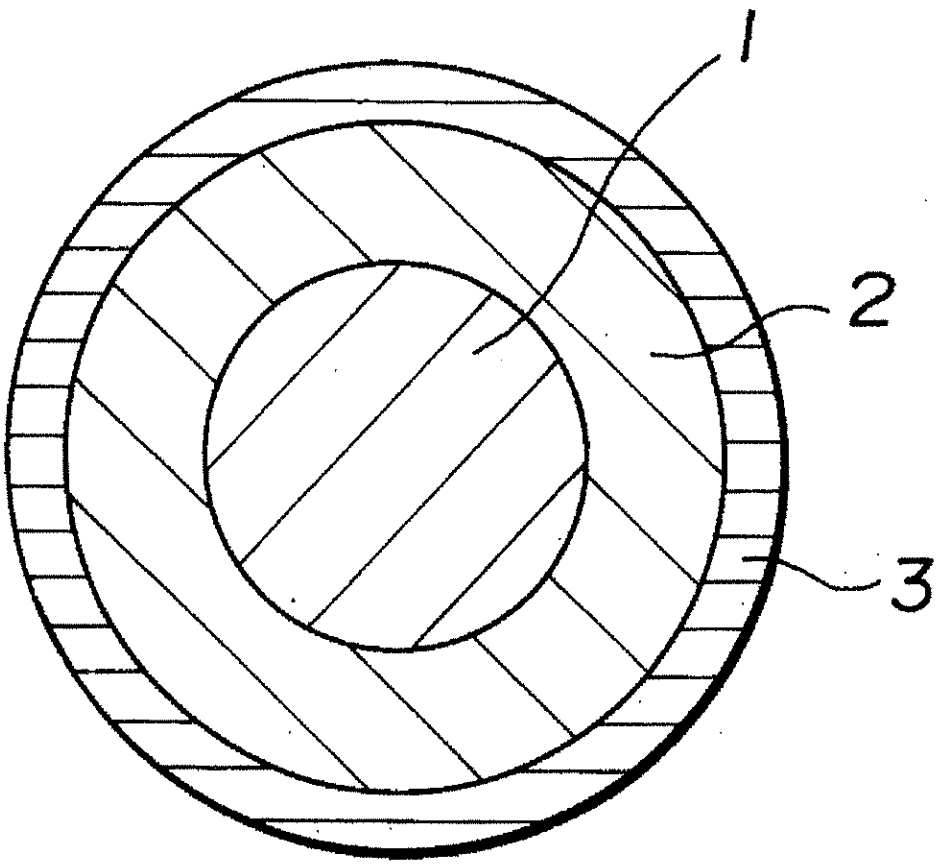


FIG.1



THREE-PIECE SOLID GOLF BALL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to three-piece solid golf balls comprising a center core, an intermediate layer, and a cover and more particularly, to three-piece solid golf balls which are improved in feeling on impact, controllability, and durability.

2. Prior Art

Among a variety of golf balls, thread-wound golf balls and solid golf balls are now popular. The solid golf balls are currently increasing to be a mainstream product. Among them, two-piece solid golf balls consisting of a core and a cover are most widespread.

Most amateur golfers are fond of two-piece solid golf balls which have excellent flying performance and durability although these balls have the disadvantages of a very hard feel on hitting and low control due to rapid ball separation on hitting. For this reason, many of professional golfers and skilled amateur golfers who impose weight on feeling and control prefer wound golf balls, especially wound golf balls using a soft balata cover, to two-piece solid golf balls. The wound golf balls are superior in feeling and control, but inferior in flying distance and durability to the two-piece solid golf balls.

Under the present situation that two-piece solid golf balls and wound golf balls have contradictory characteristics as mentioned above, players make a choice of golf balls depending on their own skill and taste.

In order to develop solid golf balls having a hitting feel approximate to the wound golf balls, two-piece solid golf balls of the soft type have been considered. For such two-piece solid golf balls of the soft type, soft cores must be used. If the cores are soft, however, repulsion becomes low with a concomitant loss of flying performance and durability is considerably deteriorated. That is, the superior flying performance and durability which are a characteristic of two-piece solid golf balls are lost, and in an extreme case, the balls become unacceptable for practical use.

Controllability, which is required even on full shots with drivers, is most important on control shots like approach shots. In an exemplary situation that the next shot should fly beyond the bunker and a short distance from the green edge to the cup, the player who is either professional or amateur will naturally wish to hit a ball with a minimal run. Such controllability of a golf ball largely depends on spin properties.

On a full shot with a club having a relatively large loft, the club loft is dominant to that the ball itself so that almost all balls are given an appropriate amount of spin and few balls overrun. However, on a approach shot over a short distance of 30 or 50 yards, balls will significantly vary in run or controllability. The major factor causing such a difference is not a basic structure, but the identity of cover material. In two-piece solid golf balls, however, covers made of soft material are effective for improving controllability, but detrimental for gaining flying distance.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a solid golf ball which is improved in feeling and controllability while maintaining the superior flying performance and durability which are characteristic of solid golf balls, that is, improved in total balance.

In connection with a solid golf ball having a core forming the center and a cover forming the outermost layer, the inventors have found that by providing a relatively hard intermediate layer between the center core and the cover, and controlling the size and specific gravity of the core, intermediate layer and cover, the center core and core can be made relatively soft to improve feeling and controllability without deteriorating flying performance and durability. The feeling and controllability can be improved in a favorable way.

Briefly stated, an intermediate layer having a thickness of at least 1 mm, a specific gravity of less than 1.2, and a hardness of at least 85 on JIS C scale is formed around a center core having a diameter of at least 29 mm and a specific gravity of less than 1.4 and greater than the intermediate layer specific gravity. A cover having a thickness of 1 to 3 mm is formed on the outer surface of the intermediate layer to complete a solid golf ball. Then even when the center core is softened to a JIS C scale hardness of 45 to 80 and the cover softened to a JIS C scale hardness of 50 to 85, the feeling and controllability can be improved at no sacrifice of flying distance and durability. Further when the intermediate layer is formed of a resin composition based on a high repulsion ionomer resin, the hitting feel and controllability can be further improved with no sacrifice of flying distance and durability.

The present invention provides a three-piece solid golf ball comprising a center core, an intermediate layer, and a cover wherein the center core has a diameter of at least 29 mm and a specific gravity of less than 1.4, the intermediate layer has a thickness of at least 1 mm, a specific gravity of less than 1.2, and a hardness of at least 85 on JIS C scale. The cover has a thickness of 1 to 3 mm. The specific gravity of the intermediate layer is lower than the specific gravity of the center core. In one preferred embodiment, the intermediate layer is formed of a composition based on a high repulsion ionomer resin.

BRIEF DESCRIPTION OF THE DRAWING

The sole figure, FIG. 1 is a schematic cross section of a three-piece solid golf ball according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, there is schematically illustrated a typical three-piece solid golf ball according to the invention. The ball includes a spherical center core 1 forming the center of the ball and a cover 3 forming the outermost layer of the ball. A relatively hard intermediate layer 2 is disposed between the core 1 and the cover 3. The size and specific gravity of the core 1, intermediate layer 2, and cover 3 are set in specific ranges.

The center core has a diameter of at least 29 mm, preferably 29 to 37 mm and a specific gravity of less than 1.4, preferably 1.05 to 1.38. With a diameter of less than 29 mm, the intermediate layer must be relatively thick with losses of repulsion and feeling. With a specific gravity of 1.4 or more, the ball has a heavier weight which exceeds the weight requirement of golf balls.

On an impact entailing substantial deformation as found on driver shots, the player gets a feeling which largely depend on the hardness of the center core 1 and varies with the club head speed given by the player. Therefore, the

hardness of the center core **1** should be set in accordance with the head speed of the target players. In this sense, the center core hardness is not particularly limited although it preferably ranges from 45 to 80, more preferably from 60 to 80 on JIS C scale (at the center core surface).

The center core **1** is generally formed from a well-known rubber composition comprising a base rubber, co-crosslinking agent and peroxide through heating, pressing and molding steps. The base rubber may be one conventionally used in solid golf balls and preferably be selected from polybutadiene rubber and mixtures of polybutadiene rubber and polyisoprene rubber. Use of 1,4-polybutadiene rubber containing more than 90% of cis structure is preferred for high repulsion. The co-crosslinking agents used in conventional solid golf balls include zinc and magnesium salts of unsaturated fatty acids such as methacrylic acid and acrylic acid and esters of unsaturated fatty acids such as trimethylpropane trimethacrylate and they may be used in the present invention. Zinc acrylate is preferred for high repulsion. The co-crosslinking agent is blended in amounts of about 15 to 30 parts by weight per 100 parts by weight of the base rubber. The peroxide may be selected from a variety of peroxides, preferably dicumyl peroxide and mixtures of dicumyl peroxide and 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane. The peroxide is blended in amounts of about 0.5 to 1 part by weight per 100 parts by weight of the base rubber. If desired, zinc oxide and barium sulfate may be blended in the rubber composition for specific gravity adjustment while antioxidants may also be blended.

The intermediate layer **2** has a radial thickness of at least 1 mm, preferably 1.5 to 3.5 mm, a specific gravity of less than 1.2, preferably 0.9 to 1 and lower than the center core specific gravity, and a hardness of at least 85, preferably 85 to 100 on JIS C scale. With a thickness of less than 1 mm, repulsion is lowered to reduce flying distance. With a specific gravity of 1.2 or more, the center core must have a relatively low specific gravity so that the golf ball may be increased in inertia moment and reduced in spin property and thus lose some controllability. A similar detrimental effect is observed when the intermediate layer specific gravity is greater than the center core specific gravity. A layer with a JIS C scale hardness of less than 85 detracts from flying performance. The intermediate layer preferably has an outer diameter of 38 to 41 mm though not limited thereto. Also preferably the difference in specific gravity between the center core and the intermediate layer is 0.1 or more, especially 0.1 to 0.5 though not limited thereto.

The intermediate layer **2** is effective in compensating for lowering repulsion of the center core **1** which is made soft. It is then formed of a relatively hard (JIS C scale hardness≧85), repulsive material. Although the material is not critical, preferred materials are ionomer resins, for example, Himilan 1706 and 1605 commercially available from Mitsui-dupont Polychemical K.K. and Surlyn commercially available from E.I. dupont. A 1:1 blend of Himilan 1706 and Himilan 1605 is most preferred. In addition to the ionomer resin, the composition of which the intermediate layer is formed may further contain weight control agents, for example, inorganic fillers such as zinc oxide and barium sulfate, coloring agents such as titanium dioxide, and other additives.

The cover **3** has a radial thickness of 1 to 3 mm, preferably 1.5 to 2.5 mm. A cover more than 3 mm thick is low in repulsion whereas a cover less than 1 mm thick is low in durability such as cut resistance. Although the hardness of the cover **3** is not particularly limited, it is preferably set in a relatively soft range of 50 to 85, more preferably 60 to 85 on JIS C scale because in this range, improvements in all of repulsion (flying performance), durability and controllability are expected.

The cover **3** is generally formed of resinous materials which are conventionally used as the cover of solid golf balls, preferably those materials which are relatively soft (JIS C scale hardness 50 to 85) and highly repulsive. Examples include ionomer resins such as Himilan 1650 commercially available from Mitsui-dupont Polychemical K.K., Surlyn 8120 commercially available from E.I. dupont, and mixtures thereof, thermoplastic polyester elastomers such as Hytrel 4047 commercially available from Toray-dupont K.K., and balata resins. If necessary, inorganic fillers may be blended in these resins for coloring purposes.

EXAMPLE

Examples of the present invention are given below by way of illustration and not by way of limitation.

Examples and Comparative Examples

Using a center core, intermediate layer, and cover having the composition shown in Table 1, three-piece solid golf balls (Examples 1–6, Comparative Examples 1–3) were prepared. The center core was prepared by kneading the respective components in a roll mill and pressure molding at 155° C. for 15 minutes. The intermediate layer was formed by injection molding so as to enclose the outer surface of the center core. The cover was formed around the intermediate layer by injection molding. The three-piece solid golf balls were completed in this way. The parameters associated with the core, intermediate layer and cover are shown in Table 2.

The golf balls were evaluated for spin characteristic, flying performance, feeling, and durability by the following tests. The results are shown in Table 2.

Spin Characteristic

Using a swing robot manufactured by True Temper Co., the ball was hit by the driver at a head speed of 45 m/s (abbreviated as W1 HS45 in Table 2) and by the sand wedge at a head speed of 17.6 m/s (abbreviated as SW HS17.6 in Table 2). The ball spin (rpm) was observed using a science eye (manufactured by Bridgestone Corporation).

Feeling

Professional golfers evaluated a feeling on impact according to the following criterion.

○: good
Δ: average
×: poor

Flying Performance

In the spin and feeling tests, the flying distance the ball traveled was also measured. Total evaluation was made according to the following criterion.

○: good
Δ: average
×: poor

Durability

Using a flywheel hitting machine, the ball was repeatedly hit at a head speed of 38 m/s until the ball was broken. With the number of hits counted, the ball was rated according to the following criterion.

○: good
Δ: average
×: poor

TABLE 1

	Example						Comparative Example		
	1	2	3	4	5	6	1	2	3
Center core									
Cis-1,4-polybutadiene	100	100	100	100	100	100	100	100	100
Zinc acrylate	20	20	20	30	20	20	20	25	20
Zinc oxide	56	36	36	20	23	10	90	25	55
Antioxidant	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Dicumyl peroxide	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Intermediate layer									
Himilan 1706	50	50	50	50	50	50	50	50	50
Himilan 1605	50	50	50	50	50	50	50	50	50
Cover									
Himilan 1650	50	50	50			50	50		50
Surlyn 8120	50	50	50			50	50		50
Hytrel 4047				100				100	
Trans-isoprene rubber					90				
Natural rubber					10				

Note:
The amounts of components blended are parts by weight and their proportion is independent among the center core, intermediate layer, and cover.

TABLE 2

	Example						Comparative Example		
	1	2	3	4	5	6	1	2	3
Center core									
Outer diameter, mm	31.52	35.28	35.28	35.28	35.29	36.40	27.68	35.24	31.52
Hardness, JIS C	66	66	66	79	66	66	66	73	66
Specific gravity	1.36	1.24	1.24	1.19	1.16	1.07	1.56	1.19	1.35
Intermediate layer									
Thickness, mm	3.4	1.7	2.2	2.2	1.7	2.0	5.7	1.8	1.6
Hardness, JIS C	91	91	91	91	91	91	91	82	91
Specific gravity	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.97	0.95
Outer diameter, mm	38.35	38.73	39.65	39.66	38.73	40.40	39.00	38.91	34.56
Cover									
Thickness, mm	2.2	2.0	1.5	1.5	2.0	1.8	1.8	1.9	4.0
Specific gravity	0.97	0.97	0.97	1.10	1.13	0.97	0.97	1.10	0.97
Hardness, JIS C	82	82	82	61	78	82	82	61	82
Ball									
Outer diameter, mm	42.68	42.67	42.67	42.70	42.70	44.00	42.65	42.63	42.65
Weight, g	45.50	45.45	45.50	45.55	45.53	45.60	45.50	45.55	45.50
Performance									
Spin (rpm) WI HS45	3300	3020	3030	3920	3600	3030	35	3600	3250
SW HS17.6	3900	4000	4300	6390	5800	4100	4100	4050	3500
Feeling	Δ	○	○	Δ	○	○	X	○	○
Flying performance	○	○	○	○	Δ	○	X	X	X
Durability	○	○	○	○	○	○	○	○	○

As is evident from Table 2, the three-piece solid golf balls of the present invention have a good balance of properties in that the center core and cover can be made soft to ensure a pleasant feeling and controllability (spin) without deteriorating flying performance and durability.

There has been described a three-piece solid golf ball which includes a core, intermediate layer and cover having controlled size, hardness and specific gravity so that the ball has a good total balance of properties in that a relatively soft center core and cover are used to ensure a pleasant feeling and controllability at no sacrifice of flying performance and durability.

Japanese Patent Application No. 5-193065 is incorporated herein by reference.

Although one preferred embodiment have been described, many modifications and variations may be made thereto in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

We claim:

1. A three-piece solid golf ball comprising;

a center core, an intermediate layer, and a cover enclosing the core through the intermediate layer,

said center core having a diameter of at least 29 mm and a specific gravity of less than 1.4,

said intermediate layer having a thickness of at least 1 mm, a specific gravity of less than 1.2, and a hardness of at least 85 on JIS C scale, the specific gravity of said intermediate layer being lower than the specific gravity of said center core, and

said cover having a thickness of 1 to 3 mm and being softer than said intermediate layer.

2. The golf ball of claim 1 wherein said intermediate layer is formed of a high repulsion ionomer resin base composition.

3. The golf ball of claim 1 wherein said center core has a hardness of 45 to 80 on JIS C scale and said cover has a hardness of 50 to 85 on JIS C scale.

4. The golf ball of claim 1 wherein said center core is comprised of a polybutadiene base rubber composition.

5. The golf ball of claim 1 wherein the diameter of said center core is in the range of 29–37 mm.

6. The golf ball of claim 1 wherein a difference in the specific gravity between the center core and the intermediate layer is in the range of 0.1 to 0.5.

7. The golf ball of claim 1 wherein the specific gravity of said intermediate layer is in the range of 0.9 to 1.0.

8. The golf ball of claim 1 wherein the hardness of said intermediate layer is in the range of 85–100 on JIS C.

* * * * *

EXHIBIT 2

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EXHIBIT 3

THIS EXHIBIT HAS BEEN REDACTED IN ITS ENTIRETY

EXHIBIT 4

United States Patent [19]

Saito

[11] **Patent Number: 4,919,434**

[45] **Date of Patent: Apr. 24, 1990**

[54] **GOLF BALL**

[75] Inventor: **Tasuku Saito**, Tokorozawa, Japan

[73] Assignee: **Bridgestone Corporation**, Tokyo, Japan

[21] Appl. No.: **223,934**

[22] Filed: **Jul. 25, 1988**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 53,123, May 22, 1987, abandoned.

[30] **Foreign Application Priority Data**

May 23, 1986 [JP] Japan 61-117160

[51] **Int. Cl.**[5] **A63B 37/12**

[52] **U.S. Cl.** ..... **273/235 R**; 273/218

[58] **Field of Search** ..... 273/235 R, 235 A, 235 B, 273/220, 218, 62, 230

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Primary Examiner—George J. Marlo

Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch

[57] **ABSTRACT**

Disclosed herein is a two-piece type solid golf ball formed by enclosing a solid core with a thermoplastic resin cover. It provides a long overall distance, improved controlability, extended durability, and good shot feeling. The solid core contains polybutadiene having more than 40% of cis-1,4 bonds and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene and deforms 1.5 to 3.5 mm under a constant load of 100 kg. The cover is 0.4 to 2.2 mm thick and consists of a 0.1 to 2 mm thick inner layer and a 0.1 to 1.5 mm thick outer layer enclosing the inner layer, both made of thermoplastic resins, said inner layer generating a stress of 20 to 100 kg/cm^2 at 10% elongation and having a resilience higher than 40%, and said outer layer having a flexural modulus of 2000 to 5000 kg/cm^2 and a resilience higher than 35%.

10 Claims, 1 Drawing Sheet

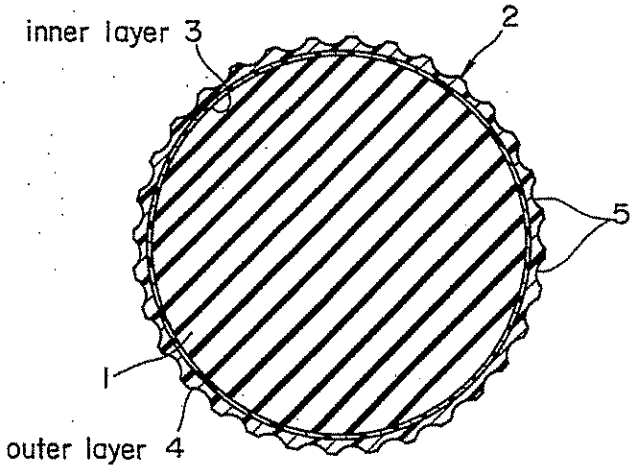


FIG. 1

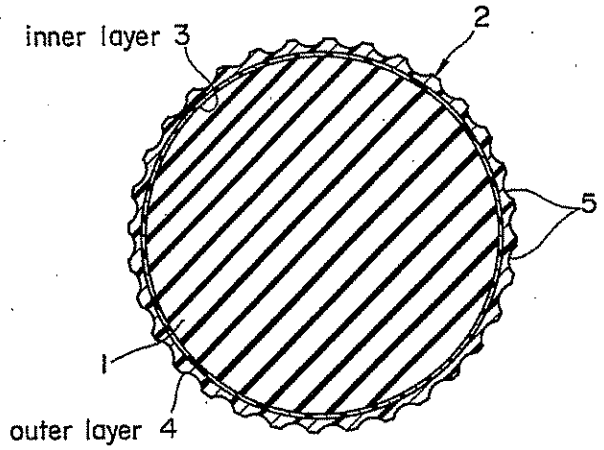
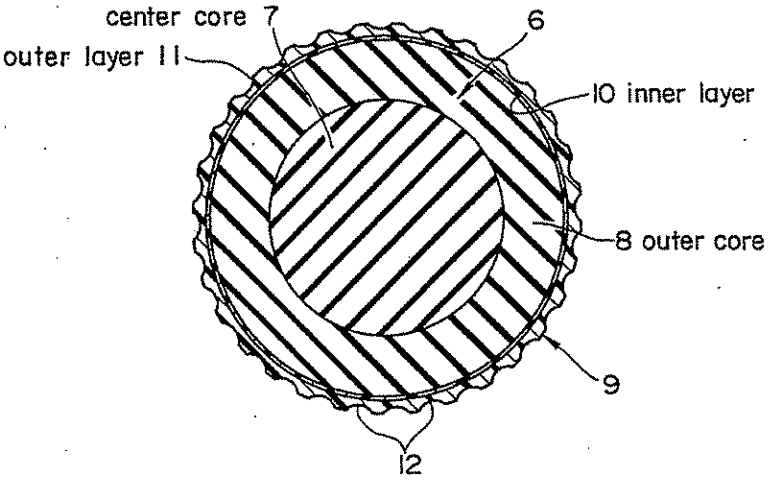

inner layer 3
2
5
1
outer layer 4

FIG. 2


center core 7
6
outer layer 11
10 inner layer
8 outer core
9
12

GOLF BALL

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application Ser. No. 053,123 filed on May 22, 1987 and now abandoned, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a two piece type solid golf ball formed by covering a solid core with a thermoplastic resin cover. More particularly, it relates to a solid golf ball which provides a long overall distance, improved controlability, extended durability, and good shot feeling.

2. Description of the Prior Art

There has been known a two-piece type solid golf ball formed by covering a solid core with a thermoplastic resin cover, said solid core being produced by mixing polybutadiene rubber, unsaturated carboxylic acid (such as methacrylic acid), zinc oxide and peroxide, and molding the mixture with heating. As the cover material, a hard ionomer resin is usually used because of its superiority in cut resistance. The solid golf ball having a cover of ionomer resin has superior durability and good flight performance. Moreover, in order to improve the coefficient of restitution (initial velocity at impact) of a solid golf ball, there has been proposed an idea of increasing the thickness of the ionomer resin cover to about 2.1 to 2.5 mm (Japanese Patent Laid-open Nos. 37961/1984 and 49780/1984).

However, as compared with a thread-wound golf ball, a solid ball is by far inferior in controlability required when the shot is made by a middle iron or short iron. In addition, a solid golf ball provides a poor shot feeling. For this reason, most professional golfers do not use solid golf balls in a tournament.

Proposals put forward for improving the shot feeling of conventional solid golf balls include lowering the hardness of the solid core and forming the cover from a soft material. Neither of these proposals provide satisfactory balls because they are possible only with the sacrifice of flight performance and durability.

On the other hand, thread-wound golf balls are used by many professional golfers in a tournament because of their superior carry and controlability. However, they are poor in durability (cut resistance and fatigue resistance). Moreover, their flight performance cannot be fully exerted and they are inferior in overall distance as compared with two-piece type solid golf balls when used by amateur players. For this reason, most amateur players use two-piece type solid golf balls.

For the improvement of thread-wound golf balls in overall distance when used by amateurs, there has been proposed an idea of replacing the core with the one which is lighter and larger in diameter and replacing the cover with the one having a higher specific gravity, thereby increasing the moment of inertia (Japanese Patent Laid-open No. 129072/1984). Despite this proposal, the conventional thread-wound golf balls are not comparable to two-piece type solid golf balls in overall distance and durability.

Accordingly, there has been a demand for golf balls which have as long overall distance and durability as solid golf balls and as good controlability and shot feeling as thread-wound golf balls. Nevertheless, almost no proposals have been made for such golf balls. The present invention was completed to meet the need.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a new solid golf ball which is equal to or better than conventional solid golf balls in flight performance when hit by a driver (which is designed for a long overall distance) and is equal to thread-wound golf balls in controlability when hit by a middle iron or short iron (which is designed for the accurate control of carry). In addition, the solid golf ball of the present invention provides a good shot feeling and is superior in durability such as fatigue resistance and cut resistance.

In order to achieve the above-mentioned object, the present inventor produced several types of solid golf balls on an experimental basis. They have the solid core which varies in physical properties and the cover which varies in physical properties, thickness, and the number of layers. The balls were examined for their characteristic properties by actually hitting them with various golf clubs including woods, irons, and putters. Furthermore, in order to improve the controlability of the ball, the present inventor investigated the relation between the loft angle of a club and the spin performance of a ball. As a result, it was found that the object is achieved by a solid golf ball made up of a solid core and a cover enclosing said solid core, characterized in that said solid core is one which contains polybutadiene having more than 40% of cis-1,4 bond and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene and deforms 1.5 to 3.5 mm under a constant load of 100 kg, and said cover is a 0.4 to 2.2 mm thick which consists of a 0.1 to 2 mm thick inner layer and a 0.1 to 1.5 mm thick outer layer enclosing the inner layer, both made of thermoplastic resins, said inner layer having a stress of 20 to 100 kg/cm^2 at 10% elongation and having a resilience higher than 40%, and said outer layer having a flexural modulus of 2000 to 5000 kg/cm^2 and a resilience higher than 35%. The golf ball constructed as mentioned above is equal to or better than conventional solid golf balls when hit with a wood club (which is intended for a long overall distance) in flight performance. In addition, it has excellent controlability when hit with a middle iron or short iron (which needs good control), because it has a good spin characteristics as thread-wound golf balls. It also has excellent coefficient of restitution properties to ensure a long overall distance. Further, it provides a good shot feeling and has good durability such as fatigue failure resistance and cut resistance.

According to the present invention, the soft inner cover layer improves controlability and shot feeling without decreasing the coefficient of restitution. It also permits the hard outer cover layer to have an optimum thickness because it can be molded in any form which corresponds to the shape of dimples.

On the other hand, the hard outer layer permits dimples to be formed on it, and it also affects the ball's spin characteristics according to the clubface used. In addition, it greatly contributes to improvement in the coefficient of restitution, durability, and feeling of balls.

There is disclosed in Japanese Patent Laid-open No. 92372/1983 or U.S. Pat. No. 4,431,193 a solid golf ball of a two-layered structure. According to this disclosure, the golf ball is composed of an elastic core and two

layers surrounding the core. The outer layer is made of a soft, less stiff solid resin or foamed resin. It is claimed that this solid golf ball has the characteristic coefficient of restitution and provides the same feeling and function as the balata-covered, thread-wound golf ball does.

However, the disclosure merely indicates that a ball of soft feeling can be obtained without any decrease in the coefficient of restitution. It is not concerned with the ball's spin characteristics which directly affect the flight performance and controlability. In this ball, the inner and outer cover layers are reversed in contrast with the ball of the present invention. The structure just mentioned above does not produce the effect intended in the present invention.

The above and other objects, features and advantages of the invention will be more apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a two-piece golf ball having a solid core **1** and a cover **2** consisting of an inner layer **3** and an outer layer **4** having dimples **5**.

FIG. **2** is a cross-sectional view of a three-piece golf ball having a core **6** made of a center core **7**, an outer core **8**, and a cover **9** consisting of an inner layer **10** and outer layer **11** having dimples **12**.

DETAILED DESCRIPTION OF THE INVENTION

The solid golf ball according to the present invention has a solid core and a cover enclosing the core.

According to the present invention, the solid core is one which contains polybutadiene having more than 40%, preferably more than 60%, and more preferably more than 85% of cis-1,4 bond and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene and deforms 1.5 to 3.5 mm, preferably 1.8 to 3.2 mm under a constant load of 100 kg. The deformation under a constant load of 100 kg means the amount of deformation measured when a load of 100 kg is applied to a spherical solid core.

The solid core may be incorporated with other rubbers such as styrene-butadiene rubber, natural rubber, isoprene rubber, etc. in addition to the polybutadiene rubber. The amount of polybutadiene rubber in all the rubber components should be more than 50%, preferably more than 70% by weight.

The unsaturated carboxylic acid or metal salt thereof to crosslink polybutadiene includes acrylic acid and methocrylic acid and divalent metal (e.g., zinc) salts thereof. They may be used individually or in combination with one another. The preferred amount of the unsaturated carboxylic acid or metal salt thereof is 10 to 60 parts by weight per 100 parts by weight of polybutadiene.

The solid core may also be incorporated with a filler such as zinc oxide, barium sulfate, calcium carbonate, and silica usually in an amount of 10 to 70 parts by weight per 100 parts by weight of polybutadiene; a crosslinking agent such as organic peroxides including di-cumylperoxide and 1,1-dibutylperoxy-3,5,5-trimethyl cyclohexane usually in an amount of 0.1 to 6 parts by weight per 100 parts by weight of polybutadiene; and additives which are commonly used for the molding of the solid core.

To be more specific, the solid core is produced by heat-curing a compound composed of 100 parts by weight of polybutadiene having the cis-1,4 bond, 10–30 parts by weight of acrylic acid and/or methacrylic acid, 10–70 parts by weight of filler such as zinc oxide, and 0.5–6 parts by weight of peroxide, or a compound composed of 100 parts by weight of polybutadiene having the cis-1,4 bond, 20–60 parts by weight of metal salt of unsaturated carboxylic acid (e.g., zinc acrylate and zinc methacrylate), 10–50 parts by weight of filler, and 0.1–5 parts by weight of peroxide. The heat-curing may be carried out at 110° to 190° C. for 3 to 90 minutes.

It is necessary that the solid core which is formed from the above-mentioned components with the above-mentioned curing conditions deforms 1.5 to 3.5 mm, preferably 1.8 to 3.2 mm, under a constant load of 100 kg. This amount of deformation is essential for the solid golf ball having the outstanding characteristics. If the amount of deformation is less than 1.5 mm, the resulting ball is so hard that it provides a poor shot feeling. Conversely, if it is greater than 3.5 mm, the ball is poor in the coefficient of restitution and durability. It should be noted that the solid core having the deformation of 1.5 to 3.5 mm is selected from ones obtained from the above preparation procedure.

The solid core for the two-piece ball is required to have a narrow hardness distribution. In other words, the difference between the hardness at the center of the solid core and that at outside should be less than 10%, preferably less than 5%, when measured by using a JIS (Japanese Industrial Standard)-A hardness tester.

The difference in hardness between the center and the periphery of the solid core is preferably 10% or less, more preferably 5% or less. The difference in hardness between the center and the periphery of the solid core is defined as

$$(A-B)/A \times 100\ (\%)$$

wherein "A" is the hardness of the periphery of the solid core and "B" is the hardness of the center of the solid core.

The solid core used in the present invention may be of a solid structure or of a layered structure as shown in FIGS. **1** and **2**. In the former case, the solid core is made of the above-mentioned materials and the two-piece golf ball is formed by enclosing the solid core with a cover. In the latter case, the solid core is made up of a central part (center cores) and one or more peripheral parts (outer cores) which differ from one another in hardness and/or density, although all of the layers (or the central part and peripheral parts) should contain polybutadiene having more than 40% of cis-1,4 bonds and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene and deforms 1.5 to 3.5 mm under a constant load of 100 kg, and should not differ more than 10% in hardness from one another. By enclosing the core of the layered structure with a cover, multi-layered golf balls such as three-piece golf balls are formed.

The solid core should be formed such that the diameter is 36.8–41.0 mm and the weight is 34.5–43.5 g if it is for large size balls, and the diameter is 38.3–42.3 mm and the weight is 34.5–43.0 g if it is for small size balls.

The solid golf ball of the present invention has a cover that encloses the solid core. This cover is made of a termoplastic resin and is composed of two layers, i.e., an inner layer and an outer layer.

The inner layer that directly encloses the solid core is made of a comparatively soft thermoplastic resin. It should have a stress of 20–100 kg/cm^2, preferably 30–90

kg/cm^2 at 10% elongation. The stress at 10% elongation is measured according to ASTM 638-86 which is hereby incorporated by reference. It should also have a resilience higher than 40%, preferably higher than 45% measured by a Dunlop tripsometer which is defined in British Standard No. 903. The inner layer should be 0.1–2 mm thick, preferably 0.3–1.5 mm thick. If the stress at 10% elongation is smaller than 20 kg/cm^2, the resulting golf ball is poor in the coefficient of restitution and durability; and if it is greater than 100 kg/cm^2, the resulting golf ball is poor in controlability. If the inner layer is thinner than 0.1 mm, the formation of dimples may be difficult and the resulting golf ball may be poor in durability. If the inner layer is thicker than 2 mm, the resulting golf ball is poor in the efficiency of restitution.

The thermoplastic resin for the inner layer includes, for example, ionomer resin, polyester elastomer, polyamide elastomer, thermoplastic urethane elastomer, propylene-butadiene copolymer, 1,2-polybutadiene, polybutene-1, and styrene-butadiene block copolymer. They may be used individually or in combination with one another. Preferable among them are ionomer resin, polyester elastomer, and blended materials thereof.

The polyester elastomer includes, for example, polyether-ester block copolymer, polylactone-ester block copolymer, and aliphatic and aromatic dicarboxylic acid copolymerized polyesters. The polyether-ester block copolymer is composed of a polyester hard segment and a polyether soft segment. The former is constructed of a dicarboxylic acid and a low-molecular weight diol component, and the latter is an alkylene glycol polymer having 2 to 10 carbon atoms. The dicarboxylic acid component should contain more than 40 mol % of aromatic dicarboxylic acid such as terephthalic acid. This is desirable for mechanical properties such as breaking strength and resilience. The low-molecular weight diol component is one or more than one kind of aliphatic and aromatic diol having 2 to 10 carbon atoms. The polylactone ester block copolymer is one which is obtained from the soft segment of the polyether-ester block copolymer in which the polyether is replaced by the polylactone chain. The aliphatic and aromatic dicarboxylic acid copolymerized polyesters are usually a copolymer composed of an acid component and at least one type of diol component. The acid component includes an aromatic dicarboxylic acid (such as terephthalic acid and isophthalic acid) and an aliphatic dicarboxylic acid having 2 to 10 carbon atoms, and the diol component is selected from aliphatic an aromatic diols having 2 to 10 carbon atoms. A blend of an aromatic polyester and an aliphatic polyester can also be used in the present invention.

The outer cover layer enclosing the above-mentioned inner layer is formed from a hard thermoplastic resin. It should have a flexural modulus of 2000–5000 kg/cm^2, preferably 2500–4500 kg/cm^2, measured according to ASTM D 790, Method I, Procedure B, which is hereby incorporated by reference, a resilience of higher than 35%, preferably higher than 40%, measured by a Dunlop tripsometer, and a thickness of 0.1 to 1.5 mm, preferably 0.2 to 1.4 mm. With a flexural modulus smaller than 2000 kg/cm^2, the resulting golf ball spins excessively when hit by a wood club. This impairs the flight performance which is a feature of the solid golf ball for amateur golfers. Conversely, with a flexural modulus greater than 5000 kg/cm^2, the resulting golf ball is poor in controlability when hit by an iron club. If the outer cover layer is thinner than 0.1 mm, the improvement of spin characteristics by a hard resin is not achieved and the resulting solid golf ball is poor in flight performance and durability, if it is thicker than 1.5 mm, the resulting golf ball is improved only little in controlability.

The thermoplastic resin for the outer layer includes, for example, ionomer resin, polyester elastomer, polyamide elastomer, thermoplastic urethane elastomer, propylene-butadiene copolymer, 1,2-polybutadiene, and styrene-butadiene copolymer. They may be used individually or in combination with one another. Preferable among them are ionomer resin and polyester elastomer.

The preferred ionomer resin is a polymer which is composed of a monoolefin and one or more members selected from C_3–C_8 unsaturated mono- and dicarboxylic acids and esters thereof and is crosslinked with metallic ions.

The cover made up of an inner layer and an outer layer as mentioned above should have a total thickness of 0.4 to 2.2 mm, preferably 0.5 to 2 mm. The ratio of the inner layer thickness to the outer layer thickness should preferably be 1:3 to 5:1.

The solid core can be molded in the usual way such as compression molding and injection molding from a mixture of the raw materials for the solid core. The mixing may be accomplished by using, for example, a Banbury mixer or roll mill. The molded product is heated for crosslinking. The heating temperature is 120° to 180° C. in the case where the core material is incorporated with dicumyl peroxide. The layered core can also be formed in the same manner.

The solid core can be enclosed with the cover in any manner. According to one method, for example, the double-layered cover is formed in paired hemispheres and they are made integral by heat-molding on the solid core. According to another method, the inner layer and outer layer are formed on the solid core by injection molding on top of the other.

The solid golf ball of the present invention should be formed such that the inner cover layer adheres closely to the solid core and the outer cover layer adheres closely to the inner cover layer. If adhesion between them is insufficient, the resulting ball is poor in durability and the coefficient of restitution. The close adhesion between the solid core and the inner cover layer can be achieved easily by the same manner as used for the conventional two-piece golf ball.

Furthermore, film adhesion between the inner cover layer and the outer cover layer can be achieved by applying a proper adhesive to the surface of the inner cover layer. Good close adhesion is achieved in the case where the material of the inner cover layer is miscible with the material of the outer cover layer and they are capable of fusion bonding with each other. This condition is satisfied in the following cases. (1) Both the inner layer and the outer layer are made of the same polymer. (2) The inner layer is made of a blend of soft ionomer resin and soft polyester elastomer, and the outer layer is made of hard ionomer resin. (3) The inner layer is made of soft polyester elastomer and the outer layer is made of a blend containing a proper amount of hard ionomer resin. In the above cases (2) and (3), the miscibility of the inner and outer layers is controlled by polymer blending. The polymer blending can be achieved in the usual way. The inner and outer cover layers may be incorporated with a coloring agent and filler, if necessary.

The present invention is now described concretely with reference to the following examples and comparative examples, although the invention should not be limited to the examples.

EXAMPLES AND COMPARATIVE EXAMPLES

One-piece cores for large balls were prepared by compression molding at 150° C. for 40 minutes. The molding compounds were prepared by mixing polybutadiene, zinc acrylate, zinc oxide, and dicumyl peroxide according to the formulation shown in Table 1 by using a Banbury mixer and roll mill.

The solid core was enclosed with the inner cover layer by injection molding from the material shown in Table 1. The inner cover layer was further enclosed with the outer cover layer by compression molding which had previously formed in hemisphere from the compound shown in Table 1. Thus there were obtained six types of large-sized two-piece golf balls having the characteristic properties as shown in Examples 1 to 6 in Table 1. The large sized two-piece golf balls in Comparative Examples 1 and 2 were prepared by forming the cover layer on the solid core by injection molding. The material of the cover layer is shown in Table 1.

The golf balls thus prepared were examined for characteristic properties according to the following test method.

For comparison, a commercial Surlyn-covered thread-wound golf ball (42.80 mm in diameter, with a 2.0 mm thick cover, made by Bridgestone Corporation) was examined in Comparative Example 3 and commercial balata-covered thread-wound golf ball (42.75 mm in diameter, with a 1.80 mm thick cover, made by Bridgestone Corporation) was examined in Comparative Example 4.

The results are shown in Table 1.

The characteristic properties of golf balls were evaluated as follows:

Initial velocity and spin:

Measured by photographic method by hitting a sample ball using a swing robot (made by True Temper Co., Ltd.)

Fatigue resistance and cut resistance:

<Cut resistance>

A ball is hit with a seventh iron under a pressure of 7 kg/cm^2 using a swing machine. The surface of the ball was visually observed for flaw marks.

<Fatigue resistance>

Using a throwing machine, a ball is thrown at an initial speed of 70 m/sec. against a rubber wall spaced 1.5 m from the machine. Throwing operations were repeated until failure occured. Cracking of the cover constitutes failure.

The properties of cut resistance and fatigue resistance are expressed in relative value provided that the ball of Comparative Example 1 has a value of 100.

Controlability:

<Controlability>

Fifteen professional golfers hit balls (90 balls per one golfer) to evaluate these properties. The controlability is that of a ball when hit with an iron.

Evaluation is made in three ranks. For controlability E is excellent, G is good, and B is bad.

TABLE 1

	Example No.						Comparative Example No.			
Items	1	2	3	4	5	6	1	2	3	4
Solid core										
cis-1, 4-polybutadiene	100	100	100	100	100	100	100	100	Prior Art	Prior Art
Zinc acrylate	35	35	35	35	35	33	33	35	Golf Ball	Golf Ball
Zinc oxide	2.5	4.5	8	12	13	15	17	17	(Surlyn-covered	(Balata-covered
Dicumyl peroxide	1.0	1.0	1.0	0.8	0.8	0.8	0.8	1.0	thread-wound	thread-wound
Diameter (mm)	41.8	40.9	39.9	39.8	39.8	38.8	38.3	38.3	golf ball)	golf ball)
Deformation (mm) *1	2.3	2.2	2.3	2.8	2.8	3.1	3.0	2.3		
Inner cover layer										
Ionomer resin	100	—	30	30	80	70	—	100		
Polyester elastomer *2	—	100	70	70	20	30	—	—		
Titanium dioxide	2	2	2	2	2	2	—	2		
Stress at 10% elongation (kg/cm^2)	80	65	40	40	30	60	—	80		
Resilience (%)	45	56	60	60	62	45	—	45		
Thickness (mm)	0.3	0.5	1.3	0.5	1.0	0.8	—	2.2		
Outer cover layer										
Ionomer resin	100	—	—	100	90	100	100	—		
Polyester elastomer	—	100	100	—	10	—	—	—		
Titanium dioxide	2	2	2	2	2	2	2	—		
Flexural modulus (kg/cm^2)	4000	3100	2500	3750	3600	4000	3750	—		
Resilience (%)	54	45	51	53	52	54	53	—		
Thickness (mm)	0.2	0.5	0.2	1.0	0.5	1.4	2.2	—		
Total cover thickness (mm)	0.5	1.0	1.5	1.5	1.5	2.0	2.2	2.2		
Physical properties of ball										
Deformation (mm) *1	2.2	2.1	2.3	2.6	2.7	2.8	2.6	2.2	2.5	2.3
Weight (g)	45.3	45.5	45.4	45.6	45.5	45.4	45.4	45.6	45.5	45.6
Initial velocity (m/s), driver	65.3	65.2	65.4	65.1	65.2	64.9	64.7	63.4	64.6	64.8
Spin (rpm), driver	3750	3650	3800	3600	3700	3600	3500	4300	4500	4900
Spin (rpm), 7-iron	7800	7500	7750	7000	7700	6500	4900	6900	7500	8100
Fatigue resistance (index)	98	97	100	97	105	100	100	100	45	60
Cut resistance (index)	95	97	98	100	100	100	100	99	75	35
Controlability, iron	E	E	E	G	E	G	B	E	E	E

Note to Table 1.
*1: Deformation under a constant load of 100 kg.
*2: Polyester elastomer composed of terephthalic acid, 1,4-butanediol, isophthalic acid, and polytetramethyleneoxide glycol.

It is noted from Table 1 that, as compared with the golf ball of Comparative Example 1 which is a conventional two-piece golf ball having a one-layer hard cover, the invention golf balls have improved initial velocity which will give improved flying distance. With respect to the spin characteristic upon hitting the ball with a 7th iron, the invention golf balls show 130 to 160% increase as compared with the golf ball of Comparative Example 1, and therefore the invention golf balls are superior in controlability than the conventional two-piece golf ball. Further, the invention golf balls have substantially the same fatigue resistance and cut resistance as the golf ball of Comparative Example, i.e. the conventional two-piece golf ball and thus have good durability.

The golf ball of Comparative Example 2 which is a two-piece golf ball having a one-layer soft cover has almost the same spin characteristic by a 7th iron as the invention golf balls. However, the golf ball of Comparative Example 2 has much spin by a driver and small initial velocity as compared with the invention golf balls. Therefore, the golf ball of Comparative Example 2 will be inferior in flying distance than the invention golf balls.

Although the conventional thread-wound golf balls of Comparative Examples 3 and 4 have good spin characteristic by a 7th iron, they have remarkably inferior fatigue resistance and cut resistance resulting in worse durability.

On the other hand, the solid golf ball of the invention has improved flight performance, spin characteristics, efficient of restitution, controlability, and fatigue resistance.

What is claimed is:

1. A solid golf ball comprising a solid core and a cover enclosing said solid core, characterized in that said solid core is one which contains polybutadiene rubber having more than 40% of cis-1,4 bonds and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene rubber and deforms 1.5 to 3.5 mm under a constant load of 100 kg, and said cover is a 0.4 to 2.2 mm thick which consists of a 0.1 to 2 mm thick inner layer and a 0.1 to 1.5 mm thick outer-layer enclosing the inner layer, both made of thermoplastic resins, said inner layer having a stress of 20 to 100 kg/cm^2 at 10% elongation measured according to ASTM 638-86 and having resilience higher than 40% measured by a Dunlop tripsometer which is defined in British Standard No. 903, and said outerlayer having flexural modulus of 2000 to 5000 kg/cm^2 measured according to ASTM D 790 and a resilience higher than 35% measured by a Dunlop tripsometer as defined above.

2. The golf ball as claimed in claim 1 wherein the difference between the hardness at the center of said solid core and the hardness at the outside of said solid core is less than 10%.

3. The golf ball as claimed in claim 1 wherein said solid core is one which contains polybutadiene rubber having more than 85% of cis-1,4 bond and an unsaturated carboxylic acid and/or a metal salt thereof to crosslink the polybutadiene rubber and deforms 1.8 to 3.2 mm under a constant load of 100 kg.

4. The golf ball as claimed in claim 1 wherein said solid core contains said polybutadiene rubber and at least one rubber selected from the group consisting of styrene-butadiene rubber, natural rubber and isoprene rubber, and the amount of said polybutadiene rubber being more than 50% by weight of all of the rubbers.

5. The golf ball as claimed in claim 1 wherein the amount of the unsaturated carboxylic acid or metal salt thereof is 10 to 60 parts by weight for 100 parts by weight of said polybutadiene rubber.

6. The golf ball as claimed in claim 1 wherein said cover is a 0.5 to 2 mm thick which consists of a 0.3 to 1.5 mm thick inner layer and a 0.2 to 1.4 mm thick outer layer enclosing the inner layer, said inner layer having a stress of 30 to 90 kg/cm^2 at 10% elongation and having a resilience higher than 45%, and said outer layer having a flexural modulus of 2500 to 4500 kg/cm^2 and a resilience higher than 40%.

7. The golf ball as claimed in claim 1 wherein said inner layer comprises at least one thermoplastic resin selected from the group consisting of ionomer resin, polyester elastomer, polyamide elastomer, thermoplastic urethane elastomer, propylene-butadiene copolymer, 1,2-polybutadiene, polybutene-1 and styrene-butadiene block copolymer, and said outer layer comprises at least one thermoplastic resin selected from the group consisting of ionomer resin, polyester elastomer, polyamide elastomer, thermoplastic urethane elastomer, propylene-butadiene copolymer, 1,2-polybutadiene and styrene-butadiene copolymer.

8. The golf ball as claimed in claim 1 wherein the ratio of the inner layer thickness to the outer layer thickness is 1:3 to 5:1.

9. The golf ball as claimed in claim 1 wherein said unsaturated carboxylic acid and/or metal salt thereof is respectively acrylic acid or methacrylic acid and/or a divalent metal salt thereof.

10. The golf ball as claimed in claim 1, wherein said metal salt of said carboxylic acid is zinc acrylate or zinc methacrylate.

* * * * *

EXHIBIT 5

THIS EXHIBIT HAS BEEN REDACTED IN ITS ENTIRETY

EXHIBIT 6

THIS EXHIBIT HAS BEEN REDACTED IN ITS ENTIRETY

EXHIBIT 7

THIS EXHIBIT HAS BEEN REDACTED IN ITS ENTIRETY

EXHIBIT 8

Slip Copy, 2006 WL 3253636 (N.D.Ill.)
(Cite as: Slip Copy)

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Auto Meter Products, Inc. v. Maxima Technologies & Systems, LLC
N.D.Ill.,2006.
Only the Westlaw citation is currently available.
United States District Court,N.D. Illinois, Eastern Division.
AUTO METER PRODUCTS, INC., Plaintiff,
v.
MAXIMA TECHNOLOGIES & SYSTEMS, LLC, Defendant.
No. 05 C 4587.

Nov. 6, 2006.

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MEMORANDUM OPINION AND ORDER

NOLAN, Magistrate J.

*1 Plaintiff Auto Meter Products, Inc. has filed suit against Defendant Maxima Technologies & Systems, LLC alleging trademark infringement and unfair competition under 15 U.S.C. §§ 1114 and 1125, and under Illinois common law. Currently before the court is Auto Meter's motion to compel complete answers to Interrogatory Nos. 12, 13, and 15. For the reasons set forth below, the motion is granted in part and denied in part.

BACKGROUND

Auto Meter develops, manufactures, and sells automotive measuring instruments, such as tachometers, speedometers, and gauges for measuring oil pressure, oil temperature, water temperature, vacuum, fuel pressure, and fuel levels. In connection with that business, Auto Meter owns the Super Bezel Trademark, Principal Registration No. 2,883,435 (the '435 Registration), and the " ULTRA-LITE" trademark, Principal Registration No. 1,967,655 (the '655 Registration). It also owns the trade dress for the "Monster Tachometer."

On May 16, 2003, Auto Meter filed a complaint with the International Trade Commission ("ITC") seeking to stop 19 respondents from importing and selling imitation tachometers and gauges that infringe Auto Meter trademarks. Maxima was not a respondent in that action, but was involved as a third party and produced documents to the named respondents. In this lawsuit against Maxima, Auto Meter alleges that Maxima's "Stewart Warner Performance" series of tachometers, gauges, and speedometers infringes the '435 and '655 Registrations, and the Monster Tachometer Trade Dress.

Prior to the close of fact discovery, Auto Meter served Maxima with several contention interrogatories, including the following:
Interrogatory No. 12: State fully the basis, including all supporting facts, documents, exhibits, testimony and/or expert opinions, for Maxima's allegations in paragraphs 1-5 of its affirmative defenses that Auto Meter's Super Bezel Trademark, Associated Trade Dress, and Monster Tachometer Trade Dress are functional and that Auto Meter is not entitled to any trade dress protection; that Auto Meter's Super Bezel Trademark, Associated Trade Dress, and Monster Tachometer Trade Dress are not inherently distinctive and have not acquired secondary meaning; that the relief requested in Auto Meter's Complaint is barred by laches and that Auto Meter unreasonably delayed in filing suit; and that Maxima's use of the term "Ultra-Shift Light" constitutes a fair use.
Interrogatory No. 13: State fully the basis,

including all supporting facts, documents, exhibits, testimony and/or expert opinions, for Maxima's allegation that its accused products do not infringe Auto Meter's trade dress and trademark rights asserted in this action.
Interrogatory No. 15: State fully the basis, including all supporting facts, documents, exhibits, testimony, and/or expert opinions, for Maxima's counterclaim.

Maxima initially responded to these interrogatories on February 7, 2006, directing Auto Meter to its amended answer and stating that "other facts may be disclosed in the course of discovery." (Ex. 4 to Pl. Mem., at 9-11.) On June 30, 2006, Maxima submitted supplemental responses stating that " [d]iscovery is on-going and Maxima will supplement this response as discovery progresses." With respect to Interrogatory No. 15, Maxima further directed Auto Meter to "the documents produced in response to Auto Meter's document requests." (Ex. 5 to Pl. Mem., at 9-10.)

*2 Maxima supplemented its discovery responses a second time on September 6, 2006, the original deadline for fact discovery.[FN1] Auto Meter found these responses inadequate and ultimately filed a motion to compel on September 29, 2006. On October 5, 2006, Auto Meter conducted a continued deposition of Maxima's President and CEO Oddie Leopando, who had been designated as the company's Rule 30(b)(6) witness and who was originally deposed on August 17, 2006. During the continued deposition, Auto Meter questioned Mr. Leopando about the September 6, 2006 supplemental responses. On October 17, 2006, Maxima supplemented its responses a third time, adding still new contentions in support of its defenses and counterclaim. (Ex. B to Def. Resp.) Auto Meter insists that Maxima should be barred from relying on "any contentions, factual bases, and documents not fully disclosed in its October 17 supplemental response, or in its August 17 and October 5 Rule 30(b)(6) depositions." Auto Meter also seeks to recover attorneys' fees and costs incurred in pursuing this motion to compel.

FN1. On September 11, 2006, the court agreed to extend fact discovery to October 6, 2006. (Minute Order of 9/11/06, Doc. 51.)

DISCUSSION

Contention interrogatories, such as those at issue here, basically "require the answering party to commit to a position and give factual specifics supporting its claims." *Ziemack v. Centel Corp.*, No. 92 C 3551, 1995 WL 729295, at *2 (N.D.Ill.Dec.7, 1995). "When one party poses contention interrogatories after considerable discovery, and the opposing party refuses to answer the interrogatories, courts routinely compel the resisting party to answer the interrogatories." *Calobrace v. American Nat'l Can Co.*, No. 93 C 999, 1995 U.S. Dist. LEXIS 1371, at *3 (N.D.Ill. Feb. 3, 1995) (citing *Rusty Jones, Inc. v. Beatrice Co.*, No. 89 C 7381, 1990 WL 139145, at *2 (N.D.Ill. Sept.14, 1990)).

A. Interrogatory Nos. 12 and 15

Interrogatory No. 12 seeks information regarding Maxima's affirmative defenses. Interrogatory No. 15 requests the facts and documents supporting Maxima's counterclaim, which seeks cancellation of Auto Meter's Super Bezel Trademark based on Maxima's affirmative defenses. Auto Meter argues that Maxima has engaged in a pattern of providing deficient answers to these interrogatories, and then serially supplementing those answers with new allegations and citations. For example, at his October 5, 2006 30(b)(6) deposition, Mr. Leopando purported to disclose all of the factual bases and evidence for Maxima's functionality defense. (Leopando Dep., at 517, 518-91.) In the October 17, 2006 supplemental response, however, Maxima newly asserted that it is additionally relying on " documents addressing functionality from the International Trade Commission proceeding." (Ex. B to Def. Resp., at 3.) According to Auto Meter, the ITC record consists of more than 75,000 pages, but Maxima has not identified "a single one of the documents from that mountain of materials that it expects to rely upon for its functionality allegations. " (Pl. Reply, at 6.)

*3 Similarly, with respect to Maxima's defense that Auto Meter's trademarks/trade dress lack secondary meaning, Maxima produced at the October 5 deposition three old gauges made by the now defunct Sun Electric Company in the 1960s and 1970s. (Pl. Reply, at 6 n. 7.) Mr. Leopando then testified that these were the only historical Sun products upon which Maxima intended to rely. (Ex. E to Def. Resp., at 598-609, 615.) In the October 17, 2006 supplemental response, however, Maxima referenced some 36 additional gauges listed in the expert report of a Mr. Behrens from the ITC case. (Ex. B. to Def. Resp., at 5; Pl. Reply, at 6.) Maxima also stated for the first time that "evidence concerning third-party gauges and tachometers can be found in the production of documents and gauges which Auto Meter inspected on September 26, 2006." (Ex. B to Def. Resp., at 5.) This production apparently comprises approximately 36 bankers boxes of old gauges, automotive magazines, brochures, and documents. Auto Meter claims that Maxima has not identified which materials from those boxes support its defenses or counterclaim. Auto Meter also objects that Maxima "continues to withhold its contentions ... concerning the facts necessary to establish the relevance of those old gauges (or the other gauges it relies upon) to the use of 'secondary meaning,' *e.g.*, the channels of trade into which they are sold, their market position and market segments, features relevant to consumers, their sales and market share, etc." (Pl. Reply, at 7.)

In addition, Maxima apparently raised an entirely new contention supporting its secondary meaning defense in the October 17 supplemental response; namely, that Auto Meter's small percentage of sales to private label and original equipment customers (" OEM") eliminate the secondary meaning of the Super Bezel trademark. (Ex. B to Def. Resp., at 5.) Maxima claims that unspecified "licensed third-parties" to the Super Bezel mark and unspecified "documents produced by Auto Meter concerning OEM and private label sales and customers, artwork for OEM and private label dial faces" support this new assertion.

As for Maxima's laches defense, the company still has not produced documents Mr. Leopando mentioned at his deposition that purportedly show that Auto Meter received certain "strategic information" about Maxima's products during a Maxima plant tour. (Pl. Reply, at 8-9.) Nor has Maxima identified the individuals involved in that plant tour, or the Auto Meter personnel who allegedly spoke about the Maxima products during a trade show. (*Id*.)

At this late stage of the case, the court agrees that it is time for Maxima to fully and completely answer Auto Meter's interrogatories. Fact discovery is at an end, yet Maxima is still referencing new documents and materials supporting its defenses and counterclaim. As noted, contention interrogatories " require the answering party to commit to a position and give factual specifics supporting its claims." *Thomas & Betts Corp. v. Panduit Corp.*, No. 93 C 4017, 1996 WL 169389, at *2 (N.D.Ill. Apr.9, 1996). The Federal Rules, moreover, "are designed to promote liberal discovery in an effort to narrow the issues for trial and prevent unfair surprise." *Wright v. Touhy*, No. 97 C 742, 2003 WL 22439864, at *4 (N.D.Ill. Oct.28, 2003).

*4 Maxima is ordered to identify (1) the specific ITC documents that support its functionality defense; (2) the specific gauges and documents from the September 26, 2006 inspection and the Behrens report that it intends to rely upon for its secondary meaning defense; (3) the facts supporting the relevance of these third-party gauges; (4) the documents Mr. Leopando mentioned at his deposition, and any other documents that purportedly show that (a) Auto Meter received certain "strategic information" about Maxima's products during a Maxima plant tour, and (b) Maxima suffered prejudice from Auto Meter's delay in pursuing its claims; (5) the Auto Meter personnel who participated in the Maxima plant tour and/or attended the trade show, and the specific statements they made which support Maxima's laches defense; and (6) the specific documents and data supporting Maxima's assertion that Auto Meter's small percentage of sales to private label and original equipment customers eliminate the secondary meaning of the Super Bezel trademark. Any facts or documents not so disclosed cannot be relied upon in this case.

Contrary to Maxima's assertion, none of this information constitutes protected work product. (Def. Resp., at 8.) Auto Meter is requesting the identification of facts, documents, individuals, statements, and products supporting Maxima's defenses and counterclaim, and not Maxima's legal theories or analyses. Responses to these requests will not, as Maxima suggests, provide Auto Meter with "a 'playbook' of how Maxima will present its defenses and counterclaim at trial." (*Id.* at 10-11.) *See, e.g., Fridkin v. Minnesota Mut. Life Ins. Co.*, No. 97 C 332, 1998 WL 42322, at *4 (N.D.Ill. Jan. 29, 1998) (work-product privilege did not protect defendant from producing documents, witnesses, and industry/company policy supporting its defense); *Mead Corp. v. Riverwood Natural Resources, Corp.*, 145 F.R.D. 512, 517-18 (D.Minn.1992) (rejecting alleged infringer's work-product immunity defense to answering interrogatories that sought "objective facts upon which defenses interposed were based and the identity of persons with knowledge of those facts.") Auto Meter's motion to compel the above information is granted.

B. Interrogatory No. 13

Interrogatory No. 13 seeks information supporting Maxima's defense of non-infringement. In the October 17, 2006 supplemental response, Maxima states that it is relying on "the overall different look and impression of its products as compared to Auto Meter's; the prominent display of distinguishing brand names and the use of distinguishing packaging; [and] that there have been no instances of confusion." (Ex. B to Def. Resp., at 9.) Maxima refuses, however, to identify (1) how the Maxima products create a different look and impression, including identification of distinguishing features; (2) the distinguishing brand names, how they are displayed, and how their display supports Maxima's contention of non-infringement; and (3) the distinguishing packaging and how its use supports Maxima's contention of non-infringement. (Def. Resp., at 9.) Maxima argues that engaging in a detailed comparison of the parties' products and packages "would require Maxima to reveal its legal strategy and positions with regard to the entire case. " (*Id.*) The court disagrees.

*5 As with Interrogatory No. 12, Auto Meter seeks the facts upon which Maxima's non-infringement defense is based, and not any legal theory or analysis. Indeed, Maxima cannot prevail on its non-infringement defense in the absence of specific facts. *See, e.g., Homefront, Inc. v. Cashmere Crafts, Inc.*, No. C 05-0597 PJH, 2005 WL 3369988, at *8 (N.D.Cal. Dec.12, 2005) ("[S]imply to assert that the accused products did not actually infringe Homefront's copyrights is far from providing facts that support a defense of non-infringement.") The motion to compel is granted with respect to Interrogatory No. 13.

C. Expert Opinions

In addition to the information discussed above, Interrogatory Nos. 12, 13, and 15 all seek expert opinions supporting Maxima's defenses and counterclaim. The court agrees with Maxima that these disclosures are properly addressed pursuant to the expert discovery schedule set by this court on September 11, 2006. (Minute Order of 9/11/06, Doc. 51.) This portion of Auto Meter's motion to compel is denied.

D. Sanctions

In light of the above ruling, the court finds that Auto Meter has not been harmed by Maxima's delay in responding to the contention interrogatories and declines to award sanctions. *Commonwealth Ins. Co. v. Titan Tire Corp.*, 398 F.3d 879, 888 (7th Cir.2004) ("A district court enjoys broad discretion in declining to impose discovery sanctions and exclude evidence."); *Najieb v. Chrysler-Plymouth*, No. 01 C 8295, 2002 WL 31906466, at *3 n. 10 (N.D.Ill.Dec.31, 2002) ("Th[e] Court has broad discretion to determine whether to issue discovery sanctions.")

CONCLUSION

For the reasons stated above, Auto Meter's motion

to compel [Doc. 54] is granted in part and denied in part. Maxima is ordered to provide Auto Meter with further answers to Interrogatory Nos. 12, 13, and 15 consistent with this opinion by November 30, 2006.

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